TYPHOID FEVER;

ITS CAUSE AND PREVENTION.

ILLUSTRATED BY THE RECENT EPIDEMICS IN CROSSHILL AND EAGLESHAM.

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TYPHOID FEVER.

PUBLIC attention has lately been attracted to the occurrence of a serious epidemic of Typhoid Fever in the neighbourhood of Glasgow. The combination of circumstances which gave rise to this epidemic may occur again. The cause to which the greater number of the cases has been, I think, conclusively traced in the following pages, is a poisoned milk supply. Tainted milk, as a cause of the propagation of contagious diseases, has only recently been made the subject of inquiry, and has not yet assumed the position in the estimation, either of the public or of the medical profession, which its importance demands. As the subject is not only of local and professional, but, I believe, of national importance, I have endeavoured as much as possible, in the following pages, to avoid technicalities, so that the public may judge as to how conclusions on such a subject are arrived at. I believe that the apathy which the public display about sanitary matters, which so largely concern their dearest interests, depends greatly on their inability to understand the dissertations on these subjects which appear in the various medical and scientific papers. Ignorance begets incredulity, and incredulity begets apathy. The only way in which we shall ever lessen to any great extent the large class of preventable diseases, is by educating the public as to the causes which produce, and the means which may be taken to prevent the spread of, contagious disease.

Typhoid (or Enteric) fever is a name which is now commonly used to designate a disease which on account of its great similarity to other members of the fever family, and of the frequent absence of any characteristic skin eruption, was up till recent years frequently included under the names of Typhus, Gastric, Nervous, Intermittent, or Bilious fever, according to the class of symptoms which seemed most to characterize the individual case. A large number of cases were included under the name of Typhus, and it was on account of the great similarity of many of its symptoms to those of that disease, that it received the name of Typhoid. Now that the symptoms which distinguish it from other fevers have been pointed out, it is easily recognized. It begins, like all other fevers, with general *malaise*, chilliness, headache, giddiness, and pain in the back. These symptoms are associated with increasing fever, which usually reaches its maximum in a few days. From the 7th to the 12th day of the disease, a few circular pink coloured spots appear on the body, which remain visible three or four days. Fresh spots appear in crops all through the course of the disease. These spots may be very few or very numerous ; in some undoubted cases of typhoid, they are absent all through. There is usually diarrhœa, but this also may be absent. An average case runs its course in three weeks, and leaves the patient extremely weak, both in body and mind. It may terminate a few days sooner, or it may run on for six weeks or even two months. It is a very treacherous disease; the very mildest looking cases are not free from danger—a change for the worse may occur unexpectedly, and the patient may die within a few hours from the effects of bleeding within, or perforation of, the bowel. These complications are occasional results of small ulcers which invariably form in certain parts of the intestine in this disease. After all danger seems to be over, and the patient recovering, a relapse may occur. Typhoid is most common in persons between the ages of five and twenty-five; but it may occur at any age.

It is now almost universally admitted that typhoid is not an infectious disease in the ordinary sense of the word. It has, however, been conclusively proven that the discharges from the bowel of the patient contain within them a contagious principle. If these discharges are allowed to decompose on the bedclothes, or in the chamber utensils, there may be danger in the bedroom of the patient. Secondly, If either the discharges of the patient, or the poisonous emanations from these discharges, are allowed to taint the drinking water or any article of food, the disease certainly spreads among those who drink that water or partake of that food. Thirdly, It has been shown to be probable that, if these discharges are allowed to decompose in the soil beneath and around human dwellings, the disease may be spread by the poisonous emanations being drawn up from the soil into the houses. Fourthly, It has been proven that there is often a relation between the inhalation of sewer gases and the spread of typhoid fever. This fact is capable of two explanations. (1.) That by the inhalation of sewer gases *per se* the disease may be originated *de novo*; or, (2.) That the sewer gas is only the vehicle by which the specific poison of the disease is conveyed from the decomposing discharges of typhoid in our sewers. After a careful consideration of the evidence adduced on both sides, I have come to the conclusion that the second explanation is the true one, and that the cases in which the disease seemed to originate in the inhalation of the exhalations from decomposing organic matter, which could not have been contaminated with typhoid excreta, were more likely to have originated in some article of food contaminated by the specific poison of typhoid excreta. Fresh evidence of the truth of the conclusions above stated will be afforded in the following pages.

The importance of having the public attention directed to this subject will be seen from the following considerations:—

Typhoid fever prevails at all seasons of the year, in every community, and among every class in the nation. Of all the fever family it pays least respect to social position, or to apparent perfection of sanitary surroundings. The extent to which our royal family have suffered must be in the recollection of every one. It is calculated that, on an average, 140,000 cases of this disease occur annually in Great Britain, and that it gives rise yearly to an average of 15,000 deaths. Only those who have witnessed, or personally experienced, a severe attack of typhoid can form the slightest conception of the aggregate misery which these figures represent. The causes which produce it are so varied that in isolated cases it is usually quite impossible to trace its origin. It is only when, from a combination of circumstances, it assumes an epidemic form, that elements of doubt and uncertainty as to its causation may be eliminated by the consideration of a large number of cases. Every epidemic of any extent which has hitherto been investigated with sufficient care, has been traced to preventable causes.

TYPHOID FEVER;

ITS CAUSE AND PREVENTION.

The Epidemic in which I was specially interested, and the origin and progress of which shall form the first subject of investigation in the following pages, made its appearance in Crosshill and its neighbourhood, in the month of January last. Before that date, sporadic cases of typhoid occurred in Crosshill, as elsewhere, at irregular intervals. During the three months prior to the 18th of January, from which, in my practice, the present epidemic dates, only two cases came under my notice—the latter of the two sickened on the 25th of December. From the 18th of January to the 5th of February, my note-book recorded eleven new cases, a number so unusual as to excite a suspicion in my mind that some very unusual cause, or combination of causes, must have arisen. From the 5th till the 15th of February, no new case occurred[1]—the epidemic seemed to be dying out. In the third week, however, it broke out again with renewed violence, thirteen new cases happened in my practice in that week, and from that date it rapidly increased and assumed formidable proportions. In order to understand what follows, it is necessary that the reader should have some knowledge of the topography of the affected district.

In the year 1857, the Town Council of Glasgow purchased a large piece of ground on the eastern slope of

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[1] In all calculations of this kind I date my cases, not from the day on which I first saw the patient, but from the day on which I found, by careful inquiry, that the illness began.

Camphill, an eminence which is situated about half a mile to the south of the City boundary. The greater part of this was converted into a public park, but the lower lying portions were laid off for feuing. Between this ground and the City boundary, the district including Crosshill was owned by Mr. Dixon, a coal master, who immediately feued a considerable part of his ground for building purposes. Crosshill proper is an eminence which begins to rise almost immediately from the foot of the north-east slope of Camphill. From Crosshill to the City boundary the ground is flat, but from that point to the Clyde (a distance of about a mile), there is a gradual and uninterrupted fall, so that the district of Crosshill stands at a level considerably higher than that of the Clyde. Building operations began as soon as the park was formed, and have gone on so rapidly that it is now surrounded by a population of 14,000. It will be seen from the above, that this district is a new suburb of Glasgow which has sprung up within the last fifteen years. The surrounding places, marked on the accompanying map, are also quite recent in their construction, with the exception of the old villages of Langside and Strathbungo, which form the nuclei of large ranges of terraces and villas, which have also been built since the formation of the park.

Crosshill is built on a stratum of clay, which overlies a stratum of coal.

The coal has been removed from a considerable part of the district. The workings round the foot of the park and under Strathbungo were exhausted sixty years ago. The workings on Mr. Dixon's property were exhausted thirty years ago. The positions of the old pits, from which these workings extend, are indicated on the map.

The coal was not removed from under the higher portion, either of Crosshill or Camphill, on account of faults in the strata, which rendered the working of these parts unprofitable. Owing to the subsidence of the old coal workings, and the clayey nature of the soil, the low lying parts of the district were occasionally covered with water, which gave rise to the assertion that Crosshill was built on a swampy soil. Before the place was built upon, this ground was drained. The clay was not removed from any part of the district which has been built upon, so that no house or tenement in Crosshill has been built on a forced earth foundation. Two large sewers drain the district, the position of which are indicated on the map. That which runs down the Langside Road (marked No. 1) was built by Mr. Dixon; it enters the City near the top of Crown Street, and falls into the Blind Burn, which is now a covered sewer running down Crown Street and emptying itself into the Clyde. In Crosshill its dimensions are 3 ft. 6 in. by 2 ft. 6 in. It is egg shaped, and the gradient in Crosshill is 1 in 240, which is stated by practical men to be a very good gradient—some of the sewers in the City, especially those which cross the Glasgow Green, having a much smaller gradient. Formerly a small stream of water ran into this sewer, and it also received the surface drainage from the park, so that a considerable volume of water flowed through it; but, when the second large sewer indicated on the map was built by the City authorities to drain their own property, this stream and surface drainage were diverted into their sewer. This second sewer, which is similar in dimension and shape to sewer No. 1, crosses over by and drains Strathbungo; it empties into the Kinning House Burn, which is now conducted as a covered sewer down West Street, and so joins the Clyde. These sewers were inspected two years ago, when it was found that pieces of paper placed on the surface of the stream of sewage matter were carried along as quickly as the inspector could walk. The eastern slope of Crosshill, on which a few houses are built, drains, as indicated on the map, into the Malls Mire Burn, which joins the Clyde opposite Glasgow Green. The population of the burgh of Crosshill, the boundaries of which are indicated on the map, is estimated at 3,000. The population between the burgh and the City boundary, the houses of which drain into the same sewers, including Strathbungo, the Cathcart Road district, and the intervening district, which has been termed, for want of a better name, "No Man's Land," is 9,000. The population of Prospect Hill is estimated at 1,500, that of Langside at 400. There are no public works in the district. The prevailing winds are from the south-west, and as the only wind which carries any City smoke or gases to Crosshill is a north wind, and that rarely prevails, the atmosphere is singularly pure, considering its close proximity to the city of Glasgow. The inhabitants are mostly of the middle class and in comfortable circumstances, except in the Cathcart Road district, where the population is principally of the working class.

From the following table, which has been compiled from the Registrar-General's monthly returns, it will be seen that the death rate of the Burgh of Crosshill has been remarkably low. I have not been able to get returns for more than three years, because the place was only made a burgh three years ago:—

Years.	Number of Deaths.	Estimated Population.	Death Rate per 1000.
1872	39	2,000	19
1873	36	2,250	14
1874	45	2,600	17

During the year 1874, no death from typhoid fever occurred in the burgh of Crosshill. From January 18th till April 20th, 1875, eleven deaths have occurred in the burgh from typhoid; and in all, I have learned of twenty-five deaths having happened within the same period in connection with the epidemic as a whole.

The death rate for the Parish of Cathcart, of which Crosshill forms a part, is estimated for the past six years, as follows:

	Years.	Number of Deaths.	Estimated Population.	Death Rate per 1000.
	1869	92	6,500	14
	1870	129	7,000	18
Census year,	1871	141	7,200	20
	1872	140	7,500	19
	1873	127	8,000	15
	1874	147	8,500	17

It will be seen from the above statistics that the average death rate of the burgh of Crosshill, and the parish in which it is situated, has been 17 per thousand. The average death rate for the city of Glasgow, during the same periods, has been 30 per thousand.

The outbreak of a serious epidemic of typhoid fever in a community apparently so well situated, in a sanitary point of view, was most unexpected; and its causes demand careful inquiry.

From the 18th of January till the 31st of March I calculate that 280 cases of typhoid fever have occurred in Crosshill and its neighbourhood. The proportion in which the various parts of the district have suffered will be seen by a glance at the map. I have, as far as possible, represented every affected family by a red mark. In some of the terraces—for instance, Albert Drive, in which thirty-two families suffered from the disease, I have found it impossible to introduce as many dots as strict accuracy would require; *but I have been strictly accurate as to the locality and the number of the affected families*, where it was possible to be so. The reader must bear in mind that these terraces are from three to four stories in height, and, as they are rented in flats, there are from six to eight families in every tenement. Albert Drive consists of twenty-two tenements. It must also be noted that in many families several cases occurred, occasionally as many as six in one house. Reduced to figures, the distribution of the disease would be as follows :—

	Population.	Number of Cases.
Burgh of Crosshill, - - -	3,000	180
"No Man's Land," - - -	3,000	70
Cathcart Road District, - - -	3,500	2
Strathbungo, - - - - -	2,400	1
Prospect Hill, - - - -	1,500	5
Langside, - - - - -	400	20
		278

In addition to the above, I have ascertained that one case occurred in Crossmyloof, one in a family in Pollokshields, three cases in Glasgow, one in Bristol, and one in Edinburgh, which could be traced to Crosshill influences, and which will be referred to again. These figures have been arrived at, 1st, By information received from the burgh authorities, who instituted house to house visitation; 2nd, By information received from the Parochial Board of the Parish of Govan, which was also arrived at by house to house visitation; 3rd, By information received from the Royal Infirmary, from various private practitioners, and from my own note-book. In this way I was enabled to supplement the lists of cases received from the local authorities, and I have reason to believe that, in the above list, very few cases have been omitted.

For reasons, which will afterwards be adduced, we may consider that the epidemic came to an end in Crosshill in the last week of March. In seeking to trace the origin of this formidable outbreak, and the means by which it spread, I shall consider—1st, The nature of the soil on which Crosshill is built; 2nd, The atmospheric conditions at the time of the outbreak; 3rd, The sewerage and its connections; 4th, The water supply; 5th, The milk supply; 6th, The influence of contagion by personal contact, and by infected clothing.

1st. *Has the nature of the soil on which typhoid appears any influence on the spread of the fever, and, if so, what kind of soil favours its propagation?* Some interesting observations have recently been made on this subject by Professor Von Pettenkofer in the city of Munich.[1] The greater part of Munich is built on a stratum of gravel, varying in thickness from twenty to forty feet, which is, of course, permeable to both air and water. That rests on a stratum of marl, which is impermeable to water, and so forms a water-tight substratum to the whole district. These strata incline on both sides towards the River Isar. A stratum of gravel, however solid in appearance, consists to the extent of one-third of its bulk of intermediate spaces or pores. The disadvantage of a porous soil is that, while it allows air and water to flow through it, it also acts like a filter, which retains any organic matter liable to putrefaction which may be deposited on the ground. The soil has a certain power of rendering decomposing substances harmless; but like everything else, this has a limit. Recent investigations have shown that an active and uninterrupted communication exists between the air within our houses and that contained in the ground beneath and around them, even the stone and mortar of which the walls are built being pervious to air. When our rooms get heated up, a current of colder air flows up into them from the cellars and from the ground beneath the cellars, "and so the genial warmth of our houses may become the cause of the introduction of foul and pestiferous air from a polluted ground below." In illustration of this, Professor Pettenkofer relates the case of several people who suffered from symptoms of fever, pain in the head, and fainting. Their illness was traced to the inhalation of gas which had escaped in large quantities from the main pipe in the centre of the street, at a distance of 20 feet from the house in which these people lived. The ground was frozen above the pipes. As the weather was cold, large fires were required, and the increased heat so produced had developed a current of air from the ground into the house, the gas being sucked up with it. Professor Pettenkofer believes that the poison of typhoid fever and of cholera, which seems to spread very much in the same way, is generated in a damp, porous soil, by the decomposition of the excreta of patients suffering from the disease, these excreta having found their way into that soil, from privies, cesspools, and leaking sewers; and that the poison so generated may be drawn up into the houses built upon that soil in the manner above indicated. These diseases have been found to prevail very largely in all parts of the city of Munich with one remarkable exception. A district of the city on the right bank of the river, the upper stratum of the soil of which is clay, and so impermeable to air and water, has escaped entirely during the last two epidemics of cholera. As a proof of his conclusions, he brings out a very remarkable connection between the quantity of water which existed at particular periods in the soil, and the prevalence or non-prevalence of typhoid fever. When the ground water existed in large quantity, rising and continuing near the surface of the porous soil on which Munich is built, and so expelling and preventing the re-accumulation of the poisonous air, to which he attributes the spread of the fever, typhoid diminished; when the ground water fell, and the gases re-accumulated, it increased. The Cholera Commission of Bavaria, in 1854, arrived at the conclusion that epidemic cholera only occurred in places situated on porous ground, permeable to air and water, and in which water could be found at a moderate depth, and that places situated on impermeable soil were not visited by cholera at all, or only in isolated instances. As the propagation of typhoid fever has been found to be subject to the same laws as the propagation of cholera, and as the upper stratum of the soil of Crosshill is clay, and so impermeable to air and water, I think that the above considerations entitle us to hold that the soil had no connection either with the origin or the spread of the fever. This conclusion will be strengthened when we consider that surrounding places, such as Strathbungo and the Cathcart Road district, although situated on the same soil, have almost entirely escaped. But it may be urged that, although the soil itself is blameless, organic matter may have been deposited on the soil, the emanations from which may have originated the disease. As I have formerly stated, no part of Crosshill has been built upon forced earth. On asking a number of builders who have been concerned in the erection of tenements in various parts of the district, what kind of soil they found in digging for the foundation, the invariable reply was clay. It will be seen, however, by a glance at the map, that the clay has been removed from a field immediately to the north of Crosshill, and that that part of the field has been filled up with ashes and débris, which contain a large quantity of decomposing organic matter. The emanations from this have been extremely offensive; and when the wind blows from the north, the people living in the adjoining houses complain very much of these offensive odours; but, strange to say, in two extensive terraces in the immediate neighbourhood of this foul decomposing mass, no cases of fever have occurred, and the other houses most exposed to its influence are least affected by the disease. This is another proof, if further proof is required, that foul odours, although they may injure the health in various ways, do not give rise to typhoid fever unless the specific poison of the disease contained in the discharges of the patient is in some way introduced into the decomposing matter.

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[1] "Cholera, How to Prevent and Resist it," by Dr. Max Von Pettenkofer, translated by Hime.

2nd. *Atmospheric conditions at the time of the outbreak.* What kind of atmospheric conditions favour the propagation of typhoid fever? Universal experience proves that it prevails more largely in the autumn than at any other season of the year, and especially after summers remarkable for their dryness and high temperature. Warm, damp weather in autumn also favours the frequency of outbreaks of the disease.

As this outbreak commenced in January, after a severe frost, and as the surrounding localities which have been exposed to the same atmospheric influences have not been much affected, we may conclude that the atmospheric condition of Crosshill had no special part either in the origin or in the propagation of this epidemic.

3rd. *Did the epidemic originate in defective sewerage?* I may premise that when epidemics have been traced to defective sewerage, these epidemics have usually happened in the autumn.

The position and construction of the main sewers of Crosshill have been already referred to. It will be seen by a glance at the map that the epidemic has not been confined to these lines of drainage, but that it has also affected Langside, which drains into the River Cart. The houses first affected in Langside have separate drains which run a comparatively short distance before reaching the river. The disease appeared in these houses in the same week as that in which the first cases happened in Crosshill. Two cases happened early in the epidemic in the family of a gardener, whose house was not connected with any drain or sewer. It will also be seen by looking at the map that the sewers which drain the affected part of the district also drain Strathbungo and the Cathcart Road district; which have escaped. At the time when the epidemic began to assume formidable proportions in Crosshill, a report on eight tenements of houses in "No Man's Land" was made to the Sanitary Department of the Govan Parochial Board, of which the following are extracts :—[1]

"GLASGOW, 15*th February*, 1875.

"GENTLEMEN,—I hereby certify that I have inspected, on the 9th instant, the tenements in *Crosshill*[2] pointed out to me by Mr. Donald M'Donald, as to the supply of water, and size of supply pipe.

"A. The houses in this tenement are supplied from a cistern in the garret which is fed by a ½ inch supply pipe, having ¾ inch service pipes from cistern to water closets and jawboxes in houses. The cistern, which is 3 ft. 10 in. long, 2 ft. 9 in. wide, and 2 ft. deep, was empty at the time of my visit, and there was no water running into it, therefore the whole tenement was without water. *The overflow pipe of cistern is untrapped, and a strong current of sewage gas blows up through the pipe, which I think must, more or less, contaminate the water.*" . . . "The water closet under stair in close was very dirty; the basin, which is cast iron, tapering from seat to floor, has no proper flushing apparatus, having only a pipe bent over the side; the inside of the basin is consequently in a very filthy state. The floor has a step down of 8½ in., and the floor was covered with filth.

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[1] "Glasgow Herald," February 20th.

[2] This refers to Crosshill *district*, and the houses inspected were in 'No Man's Land."

"B. This tenement I found to be in all respects the same as A; but the water closet in close, the door of which was nailed up, being opened, I found the soil pipe choked, and the excreta overflowing the seat, and the floor covered with it. It appeared to have been in this state for a long time, as the filth was covered with white mould. The smell was most offensive, and almost unbearable.' The reports for tenements marked C, D, E, and F, are similar; no traps in overflow pipes of cisterns; sewage gas freely admitted; on the ground flats filthy water closets; only two of these six tenements had water in the cistern at the time of the inspector's visit.

G and H had kitchen jawboxes supplied from the main. No complaint of want of water, except in top flats. Two upright soil pipes in each tenement, only one of which was ventilated.

As I thought it would be very important to verify these statements, and to ascertain what effect these extremely objectionable sanitary conditions had in the propagation of the fever, I called for the sanitary inspector of the district, who furnished me with a list of the particular tenements to which this report referred. I visited these tenements on the 22nd of April, and found that the water supply to these houses was from a cistern in the garret as stated in the above report, but the privies to which the inspector referred were only used by the people who lived in the shops which occupied the basement flat of the first three tenements. The tenants living in the flats above had water closets in their houses. A considerable number of these people complained of very bad smells in the closets. They all complained of a very deficient and irregular water supply.

Here were all the conditions which would most certainly have originated a terrible outbreak of the fever, had sewer gases been at this time capable of producing it. Sewer gases admitted freely on the surface of the drinking water—sewer gases in the houses—choked and filthy privies on the common stairs. What was the result? In tenement A, occupied by eight families, only one of these families was affected; in tenements B, C, D, and E lived thirty families, among whom not a single case of the fever had occurred; in tenement F one case occurred; in tenement G two families were affected; in tenement H no case occurred. Further, the cases which did occur, occurred, as will afterwards be shown, not from sewer gas poisoning, but from a different cause.

Although defects have been discovered in the soil pipes, and in the connections of the soil pipes with the main drains in some of the affected houses in Crosshill burgh, in the majority of the affected houses no defects have been discovered. I have no facts to offer with regard to the soil pipes, or with regard to the sewer connections of Strathbungo, or of the Cathcart Road district; but, as the village of Strathbungo is very old, and inhabited, to a great extent, by a working class population—and as the population of the Cathcart Road district is almost entirely a working class population, and the houses are of a poorer description than those of Crosshill—we may be sure that the connections between the sewers and the houses situated there are at least as defective as those in Crosshill, and yet only one case has happened in Strathbungo in a population of 2,500; and only two cases, one of which was imported from Glasgow, in the Cathcart Road district, with a population of 3,500.

These considerations surely warrant me in saying that the epidemic was not caused by defects of sewerage, although, as I shall afterwards show, it may have been, to a certain limited extent, propagated thereby.

4th. *The Water Supply.*—Another source to which the origin of many epidemics has been traced is that of impure drinking water, the water having become impregnated with the specific poison of the disease. This is the most common cause in country places, where the wells are so situated that they receive the drainage from cesspools, privies, or dungsteads. When a case of typhoid is imported into a village, and the discharges of the patient are thrown into a dungstead or privy draining into a well, it immediately affects those people who drink the water of that well. An instance of this will afterwards be adduced in connection with the present inquiry. But it is not entirely confined to such circumstances. A very remarkable outbreak occurred in Cambridge University, which is supplied with gravitation water. The outbreak was confined to a new part of the university which had apparently been built on the best principles, and the sanitary arrangements of which seemed to be perfect. It was traced by Dr. Buchanan, a medical officer of the Privy Council, to the admission of sewer gas into the water pipes while empty, during an intermission in the water supply. The water closets were in this case supplied directly from the main without any intervention of a supply cistern, and the valves which ought to have kept out the sewer gas were found to be inefficient. The university sewers were connected with the sewers of a part of the town where typhoid prevailed, and so the specific poison of the disease entered the water pipes along with the sewer gas. Crosshill is supplied with water by the city of Glasgow, and has the same water supply as many other districts which are entirely free from the fever. The water closets are invariably supplied by cisterns, so that, although the supply of water is in many places intermitting, there is no likelihood of sewer gas getting into the water pipes. On these grounds I hold that the epidemic could not have been caused by a tainted water supply.

5th. *The Milk Supply.*—Of late years the dissemination of the poison of zymotic diseases by milk has attracted considerable attention; several epidemics of typhoid fever and of scarlet fever have been so connected with the milk supply of particular dairies in which these diseases were found to exist, that no one who is acquainted with the literature of this subject can doubt that the connection is something more than a mere coincidence. Illustrations of these will afterwards be given.

Very soon after the commencement of the Crosshill epidemic, I began to take notes of every circumstance connected with my patients which seemed to me to have any bearing on the causation of the disease. As the origin of so many cases by infection, in the ordinary sense of the term, seemed to me to be negatived by the occurrence of so many cases in families in no way connected, and living in different localities, I was inclined, at first, like most medical men, to blame the drainage; and I endeavoured to find faults in all the houses in which fever occurred. As might have been expected from the general ignorance, incapacity, and carelessness which seem to characterize many tradesmen of the plumber class, I did in some instances discover defects which gave a colour to this theory. Among the first families affected were two families in Langside, living in detached houses which had separate drains. These drains emptied into the River Cart at a comparatively short distance, and were not connected with the drainage of any of the surrounding houses. In both of these houses there were fixed basins in the bedrooms. In one of them, when water was left in the basin in one of the bedrooms, it was found in the morning to have an offensive smell.[1] The soil pipes were ventilated, and no smells were complained of elsewhere. Although this was not the bedroom in which the children who were first affected in that house slept, I immediately blamed the basins. In the other house I could not discover any defect. There were no smells in the house, and the soil pipes were ventilated. The drain runs down a steep declivity, a distance of only forty or fifty yards, into the river, so that sewer gases had scarcely time to form. It could not be the drainage in this case. As the cases accumulated in which I could not connect the outbreak of the disease with defects of drainage, I turned my attention to the milk supply. The following abstract from my note-book is of considerable importance to the elucidation of the question—Was the epidemic originated and propagated by a poisoned milk supply? It represents the number of cases which occurred in my practice in each week from the 18th of January till the 31st of March. It must be noted that, in making these calculations, I did not date the attack from the date of my first visit to the patient, but from the day on which I ascertained by careful inquiry that the symptoms of the illness showed themselves. It will be observed that the cases are grouped so as to indicate apparently two epidemics, the cause of which will afterwards appear:—

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[1] I have learned since writing the above that the drain of this house, in which six cases of the fever occurred, and in which the milk was got from dairy A, is connected with that of the adjoining villa, in which a family consisting of adults and children live. The milk supply of this family was not got from an Eaglesham dairy, and it has escaped.

First Epidemic.

January 18th till January 24th inclusive, . . .	6 cases.
,, 25th ,, 31st ,, . . .	3 cases.
February 1st till February 5th ,, . . .	2 cases.

No cases from February 5th till February 15th.

Second Epidemic.

February 15th till February 21st inclusive, . .	13 cases.
,, 22nd ,, 28th ,, . .	16 cases.
March 1st till March 7th inclusive, ...	18 cases.
,, 8th ,, 14th ,, ...	2 cases.
,, 15th ,, 21st ,, ...	4 cases.
,, 22nd ,, 28th ,, ...	4 cases.
	68 cases.

Of the four cases last mentioned, as occurring between the 22nd and the 28th of March, only one occurred in Crosshill; and from the 28th of March till the present date, April 27th, only one new case has occurred in my practice in Crosshill. The disease has, however, affected two families in Prospect Hill. I found, on inquiry, that ten of the patients (representing five families) who had been affected in what we may call the first epidemic in Crosshill, from the 18th of January till the 5th of February, got their milk from a dairy which I shall designate dairy A, and the eleventh, in which there was only one case, got its milk supply from a dairy which I shall designate B.

As this made out a very strong case against dairy A, I asked a neighbouring practitioner, who had, I learned, a considerable number of cases at this time, to inquire as to the milk supply among his patients; the answer I got was that the milk supply was not uniform, but was got from different dairies. The disease broke out again in the third week of February. In the first week of this second epidemic, I had eleven new cases, the milk supply of which was as follows:—

Five cases (in five families) from dairy A.
Three cases (in three families) from dairy B.
Three cases (in three families) from dairy C.

Among the first patients affected in the second epidemic was a widow living in the house of the dairyman A; she was his daughter-in-law. She sickened on the 16th; I was called to see her on the 22nd. She was naturally delicate; and having, months before, had a great deal of anxiety and overwork in nursing her late husband, she was very much broken down. The attack was severe and characteristic, and she died on the 4th of March. On the day on which I was called to see this patient, I asked the dairyman from what sources he got his milk supply. He stated that he got the greater part of it from a milk agent, who collected from several farms in the neighbourhood of Eaglesham, but that he had arranged with the agent to get milk as far as possible from only two of these farms, which I shall designate X and Z. He informed me that dairy B had exactly the same milk supply as he had; and that dairies C and D were also supplied by this agent. This information led me again to turn my attention to the milk supply of my patients, and I found that in every case that came under my notice, the milk supply was got from one of these Eaglesham dairies. I asked all my brother practitioners with whom I came in contact to make similar inquiries, and intended writing to the medical man of the village to ascertain whether the fever existed in the farms above mentioned; but, on the 24th of February, Provost Browne of Crosshill called on me to ask if I could give him any clue to the cause of the epidemic, which had by this time become very alarming, and had excited public attention. I gave him the above information, and he at once decided to send out the sanitary officer for the burgh to Eaglesham, to make personal inquiry. Mr. Grozier, the sanitary officer, returned next day with the report that typhoid fever had been epidemic in Eaglesham for some months, and that the families of several farmers in the neighbourhood had been affected. In particular, two children were ill of typhoid in the family of the Farmer X, whose milk was conveyed by the milk agent above mentioned to the Crosshill dairies. The water supply of this farmer was derived from a very questionable source; and the dungstead into which the discharges of the patients were thrown was within a few yards of the well, the water of which he used for all his domestic and dairy purposes. Next day, the 26th of February, the Commissioners of the burgh called on the four dairy proprietors A, B, C, and D, and interdicted them from selling any milk received from the Eaglesham farms. On the 1st of March, they addressed a letter to the Board of Supervision, stating the above facts, asking the board to send a medical officer to inquire into the causes of the epidemic, and to prevent, by whatever powers it might possess, the distribution of milk from the affected farms either in Crosshill or elsewhere. On the 2nd of March, with the approval of the medical officer of the Board of Supervision, they issued a circular to the inhabitants of Crosshill, of which the following is a copy:—

"The Commissioners of the burgh, having made searching inquiry with regard to the cases of typhoid fever which have happened in Crosshill and its neighbourhood, and having consulted with medical practitioners on the subject, have been advised that there is reason to believe that these are largely owing to a portion of the milk supply being taken from farms in which the disease has been found to exist.

"The Commissioners have, therefore, enjoined dealers in milk to be careful not to receive any from farms on which this disease is or has been recently; but, as a further precaution, they recommend that all the milk used by the inhabitants should be brought to the boiling-point, as there are reasonable grounds for believing that this simple measure would obviate any risk which might arise, should any milk happen yet to be brought from infected farms.

"They further recommend that a tablespoonful of Condy's disinfecting fluid be placed in the basin of the water closet, which should be renewed each time the closet is used; and to place the same quantity of Condy's fluid, mixed with a pint of water, in all fixed basins in bed-rooms.

"By order of the Sanitary Committee of the Commissioners of the burgh of Crosshill."

Next day, March 3rd, Dr. Littlejohn, the medical adviser of the Board of Supervision, came to Crosshill, and having consulted with the local medical practitioners, found that as the result of the inquiries they had made as to the milk supply of their fever patients, they were all of opinion that the fever had been originated by a poisoned milk supply. He afterwards verified the report of the sanitary inspector as to the condition of matters in Eaglesham, and inspected the drainage arrangements of Crosshill. As a result of his inspection he stated that the drainage of the district was good, and that the houses were, as a whole, superior to those of a similar description in Edinburgh. He made an interim report on the 17th of March, stating that he had conclusively traced the importation of the disease to milk from an infected district; that various measures had been taken by the Crosshill authorities at his suggestion to improve the ventilation of, and to disinfect the sewers, and predicting the speedy disappearance of the disease. His completed report, containing the evidence on which these conclusions were founded, has not yet been published. Such is a brief account of the manner in which the theory of the origin of this epidemic in a tainted milk supply arose. I shall now detail the additional evidence which I have gathered from various quarters of the connection of the fever with the milk supply from the Eaglesham dairies, and, first, I shall note my own experience of the sixty-eight patients whom I attended from 18th January till 31st March :—

Milk Supply.

	Dairy A.	Dairy B.	Dairy C.	Dairy D.	Dairy E.
43 resided in Crosshill Burgh,	19	11	10	2	1
12 ,, "No Man's Land,"	6	3	1	2	—
3 ,, Prospect Hill, .	—	—	—	—	Dairy G. 3
9 ,, Langside, . . .	9	—	—	—	—
1 ,, Pollokshields, .	1	—	—	—	—
68	35	14	11	4	4

It will be seen from this table that in sixty-four cases in my practice the milk supply could be traced to the Eaglesham dairies. The great majority of these patients got their milk supply wholly, a few of them only occasionally, from that source. Of the four patients who did not get their milk supply from the Eaglesham source, the first was a domestic in a family living opposite dairy A. She had only been in the family a fortnight. At the time of my visit she had been in bed for some days ; and as her master told me that she was ailing when she came, the probability is that she did not get her illness in Crosshill. The three following cases occurred in Prospect Hill in two families. They sickened on the same day, March 27, when the epidemic at Crosshill was practically at an end. In two of the cases I could not trace the cause of the fever to any connection with Crosshill ; in the third the patient had been in the habit of visiting and taking tea in a house at Crosshill, in which a case of typhoid was running its course. In all the cases connected with the Eaglesham supply, I ascertained that the patients did take the milk. With regard to the thirteen patients in Langside who were not under my own care I ascertained that, although they had dairies much nearer, nine were supplied wholly by dairy A, and four in one family partially by dairy B. In every case the affected members of the family took the milk, and suffered from the disease within the period which I have assigned to the Crosshill epidemic. I have also ascertained that the single case which happened in Strathbungo ended fatally on March 15th, and that the family in which this death occurred got its milk supply from dairy A.

From 18th January till 31st March, eight cases of typhoid were sent from Crosshill district to the Royal Infirmary. In six of the cases I ascertained that the dates at which these patients were admitted were as follows:—March 1st, 2; March 2nd, 1; March 5th, 1; March 10th, 1; March 17th, 1. I could not get any dates in the other two cases, nor did I get the milk supply except in one case. The case admitted on March 17th was that of a boy, aged ten years, who lived in Crossmyloof, and whose occupation was to carry the milk from dairy A. He stated that he usually had a drink of milk and some bread and butter or biscuit when he came to the dairy in the morning. He sickened on the 8th of March.

Five cases were sent from Crosshill to the Belvidere Fever Hospital; of these cases I ascertained the first day of the illness and the milk supply:—(1.) Sickened March 19th, milk supply dairy C. (2.) Sickened February 14th, milk supply dairy B. (3.) Sickened January 23rd, milk supply dairy A. (4.) Sickened March 2nd, milk supply dairy A. (5.) Sickened March 3rd, milk supply dairies B and C. The last mentioned case was that of a young man who was an assistant in a grocer's shop in Crosshill, but took his meals in Crosshill during the day. He occasionally had milk from dairies B and C. He lived in Glasgow. A case, in some respects similar to the above, has come under the observation of a medical friend. A boy, who lived in Salisbury Street, Glasgow, came to school in Crosshill; he got his food in the house of his grandmother, who got her milk supply from dairy A; he sickened in February of typhoid fever. A third case happened in Kelvingrove Street, Glasgow, in the person of a lady, who came to Crosshill, on the 29th of January, to visit her sister, who was lying with the fever. She left Crosshill on the 5th of March, and was laid down with typhoid on the 17th of March. The milk supply of the family in Crosshill was from dairy B.

The following cases were related to me by a medical neighbour:—First, a gentleman came to Crosshill on February 19th, on a visit to a family who got their milk supply from dairy B. He left Crosshill for Bristol on the 1st of March, and took ill of typhoid immediately after his arrival. He died on the 29th of March in Bristol.

Second, a lady who usually resided in Crosshill, but who had left the neighbourhood on the 8th of January, returned on the 6th of February; she remained till the 15th of February, when she went to Edinburgh. On the 20th she was seized with a shivering, but continued to go about for a week, the symptoms of typhoid fever developed, and she was confined to bed for several weeks. In this case the milk supply was from Dairy M.

The following table shows the milk supply of every family in the burgh of Crosshill, and the relation of the milk supply to the fever, as ascertained on March 24th by the Sanitary Inspector.

		Total Number of Families supplied.	Families affected with Typhoid Fever.
Eaglesham Dairies, situated in the Burgh of Crosshill,	A	69	29
	B	134	40
	C	52	20
In "No Man's Land,"	D	7	5
		262	94

Other Dairies scattered over the District outside of the Burgh of Crosshill.

	Total Number of Families supplied is	Families affected with Typhoid Fever.		Total Number of Families supplied is	Families affected with Typhoid Fever.
E	7	...	*Bt. for.,*	190	16
F	3	1	M	2	...
G	61	4	N	1	...
H	38	3	O	1	1
I	24	3	P	1	...
J	42	5	Q	7	1
K	14	...	Cond. Milk or none,	40	...
L	1	...			
Car.	*for.,*190	16		242	18

Of the 18 families affected, whose milk supply was not obtained from the Eaglesham dairies, it was ascertained, on subsequent inquiry, that 10 got occasional supplies from these dairies, so that the milk supply of 104 affected families could be traced to this source, and only 8 families affected by the disease got their entire milk supply from other sources. At the time that this return was made, it was ascertained that 40 families had left the burgh temporarily, on account of the epidemic.

A glance at the map will show that only one of the Eaglesham dairies is situated in "No Man's Land," and as the great majority of the population living there must get their milk supply from dairies not supplied by the Eaglesham milk agent, I thought it important to obtain the facts with regard to the relation of the fever and milk supply in that part of the district. Mr. Wallace, the Sanitary Inspector of the Govan Parochial Board, kindly caused the necessary inquiries to be made. The following is a copy of a letter, which I received from him on the 12th of April. I have suppressed the names of the dairies, and substituted the letters of the alphabet as before.

"Dear Sir,—I have now got returns from the most of the families in which typhoid fever existed in 'No Man's Land,' and find that, with very few exceptions, they got their milk, either in whole or in part, from one or other of the three following dairies, dairy A, dairy D, and dairy B.

"A few got milk from dairy C and dairy G, and a few we could get no returns from; but I think you may safely say that 75 per cent. got from the above three."

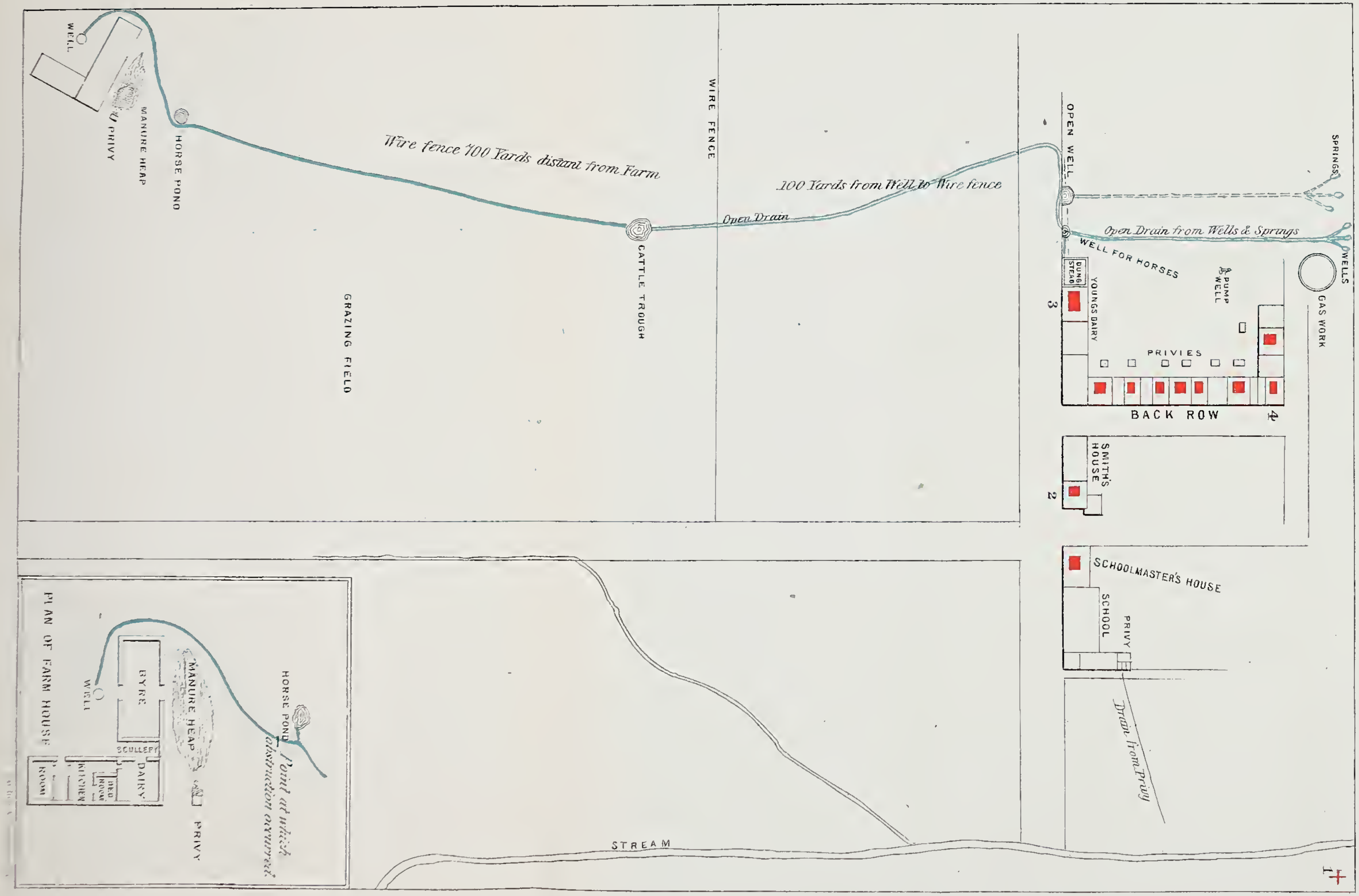
It will be seen from the above, that in "No Man's Land," wherever the facts in regard to the milk supply of the fever-stricken houses were ascertained, it was found that the milk was got from dairies A, B, C, and D, with a few exceptions in which the milk was got from dairy G. To complete the proof of this remarkable connection, I have drawn up the following table of the milk supply of the families residing in the eight tenements, the sanitary arrangements of which are reported on in pages 16 and 17. In making personal inquiry, I was careful to ask if the families got milk, either regularly or occasionally, from the Eaglesham dairies in January and February last; when I found that they did so, although they had changed their milk supply since, I marked them down to the Eaglesham dairies.

	Total Number of Families living in Tenement.	Number supplied by Eaglesham Dairies.	Number supplied by other Dairies, principally M and J.	Not ascertained.
Tenement A	8	1	6	1
" B	6	0	6	0
" C	9	0	8	1
" D	8	0	8	0
" E	7	1	6	0
" F	7	2	5	0
" G	7	4	2	1
" H	7	0	7	0
Total...	59	8	48	3

Of the total number of 59 families living in these 8 tenements, 4 families had fever; and these 4 families got their milk supply from the three Eaglesham dairies, A, B, and D, and in every case almost entirely from that source.

With the exception of one family, they were all affected in what I have called the second epidemic.

From the above facts the reader will see that there was an extraordinary connection between the distribution of the Eaglesham milk, and the spread of the disease—a connection so remarkable that it could not, in my opinion, be a mere coincidence; but must have borne the relation of cause and effect. The question now arises, how did the milk become impregnated with the specific poison of typhoid? and this brings us to the consideration of the Eaglesham epidemic, for the facts regarding which I am indebted to various gentlemen connected with Eaglesham. I have verified these facts by two visits to the village, during which I made careful inquiry about everything which seemed to me to have any bearing on the subject. On the 24th of August, 1874, a man came to Eaglesham from Glasgow, suffering from what was supposed to be a bad cold; it turned out to be a case of typhoid fever. Six or seven weeks after, a young woman took typhoid, who lived in the same house with this patient. Her illness would probably begin about the 10th of October. The locality in which these patients lived, is marked with red cross No. 1, in the accompanying map. No fresh case was known to have happened in Eaglesham, till the 20th of November, when a girl sickened in the house marked No. 2. She wrought in a mill beside a girl who lived in the above mentioned house, so that she was probably exposed to the virus of the disease while on a visit there. A few days later, a boy, aged seven years, sickened of the fever in the house of his grandfather, a dairyman and carter, who lived in house No. 3; and his sister, who lived with her parents in house No. 4, sickened about the same time. No connection could be traced between the cases of these two children, and the cases above mentioned. The only suggestion which was offered to me about the causation of these cases was that, as the grandfather was carting rags to a mill in the neighbourhood, before the children sickened, and as the bags in which the rags had been contained, were occasionally thrown down at his own door, it is possible that the children may have contracted the disease by playing with these old rag bags. No doubt, if the bags had contained, or did contain pieces of cloth contaminated by the discharges of a typhoid patent, it is possible that the disease may have been contracted in this way. It will be seen by looking at the map that this dairyman had a dungstead which actually drained into an open well, the water of which was used, he informed me, for washing and watering the horses connected with his establishment, for washing clothes and stable utensils; the water from the well and dunghill drain, was then conducted past the mouth of another open well, which was famed in the back row on account of the excellent tea which was obtained by the use of its water. Everybody, or nearly everybody, in the back row got water from this well. After a night's rain the combined dungstead drainage, and horse well water in flowing past the mouth of this well overflowed into it. A blue scum has been seen occasionally on the surface of the water, which must have been the result of some matter so conducted into it from the gas work above. Into this horrible and dangerous connection of dungstead drainage and water supply, the specific poison of typhoid was introduced. During the illness of the dairyman's grandson, he lay in the room from which the milk was sold, and his discharges were thrown into the above mentioned dungstead. Here were two dangerous combinations of circumstances. What was the result? The disease broke out there as an epidemic in December. In the back row about twenty cases of typhoid occurred in that month. And the disease was entirely confined to the vicinity of the back row in Eaglesham. In the end of December it appeared in the family of the schoolmaster, and, in all, six of his children had the disease. How did it originate in his family? He assured me that he neither got water from the polluted well, nor milk from the dairy in the back row. His children, as far as he knew, had no communication with the sick. He had, however, a privy, at the end of the school, which was common to his family and to his scholars. It is possible that some of the children in the back row had the disease in such a mild form that they were able to attend school till an advanced stage in the disease. Cases have been recorded of patients attending hospital as out-patients all through the disease. So this privy may have received the specific poison of typhoid, and the exhalations from it may have communicated the disease to his family. It may also have formed a fresh focus for the spread of the disease among the children attending school and using this privy, and may have given rise to some of the cases which were reported to have happened in the families of the surrounding farmers. This danger would certainly be increased when the discharges of the six typhoid patients in his own house came to be thrown into the dungstead behind. I have no evidence, however, to adduce in support of this theory. During the month of December and the first week of January a severe frost prevailed, and, during this frost, the discharges of twenty patients in the back row were thrown into the privies and dungsteads behind the houses and frozen up. In the end of the first week of January a thaw took place, which was accompanied and followed by rains. This five weeks' accumulation of filth, containing the specific virus of the disease, would certainly be washed down over, and through the bed of gravel which formed the soil of the gardens behind the houses in the back row into the water course, indicated on the map, which joined, as above mentioned, the drainage from the dungstead, also loaded with virus. This combined stream formed the principle source of water supply of the farmer X, whose milk was being sold in the Eaglesham daries in Crosshill. It was conducted, as indicated on the map, a distance of 800 yards, into his well, which was said to be 40 feet deep. This well was stated to


WELL
MANURE HEAP
PRIVY
HORSE POND
Wire fence 100 Yards distant from Farm
WIRE FENCE
GRAZING FIELD
CATTLE TROUGH
Open Drain
100 Yards from Well to Wire fence
OPEN WELL
SPRINGS
Open Drain from Wells & Springs
WELLS
WELL FOR HORSES
DUNG STEAD
YOUNGS DAIRY
PUMP WELL
GAS WORK
3
PRIVIES
BACK ROW
4
SMITH'S HOUSE
2
SCHOOLMASTER'S HOUSE
SCHOOL
PRIVY
Drain from Privy
STREAM
1
PLAN OF FARM HOUSE
WELL
BYRE
MANURE HEAP
HORSE POND
1
Point at which obstruction occurred.
SCULLERY
DAIRY
BED ROOM
KITCHEN
ROOM
PRIVY

have received some water from a spring; but the quantity so supplied to it was so small that, when it was not supplemented by the water conducted from Eaglesham, the farmer immediately suffered from want of water. He had an arrangement by which he could turn off this water supply from Eaglesham when the well was full; the Eaglesham water then flowed through the horse pond and watered a meadow, for which purpose it was well suited by its sewage elements. At the time when the frost broke up he found that he ran short of water, and, on examination, found that the pipe conducting the water from Eaglesham was either partially or wholly occluded by the growing roots of a tree. This was remedied soon after. It is not at all necessary to suppose that farmer X diluted his milk with this water. He washed his milk dishes with it. The virus of contagious diseases is so inconceivably subtle, that the merest taint communicated in this way might be sufficient. It has been rendered almost certain, by the recent researches of an eminent pathologist, that the virus of typhoid fever consists of living germs.[1] So that if milk, as has been argued, is one of the most congenial soils for the propagation of such fever germs,[2] a very small quantity of seed may, by self-propagation in milk, poison a whole community. A reference to the abstract from my note book (page 21) will show that the epidemic began in Crosshill on the 18th of January. As there is a period of incubation in this disease, varying from a few days to three weeks, and averaging ten days, during which no symptom of the poison germinating in the patient's body shows itself, it will be seen that the first epidemic appeared in Crosshill just at the time when it might *à priori* have been expected to do so, if originated by this poisoned milk. But it may be asked, how did it fare with the family of farmer X, who drank this poisoned water? His family consisted of four children and five adult domestics and farm servants. Including his wife and family, eleven persons drank this water. Two of the children, aged six and four years, sickened of typhoid in the end of January, or the beginning of February, poisoned by this water. They were first seen by the doctor, who attended them, on the 5th of February, but they had been complaining for some days previously. The other members of the family did not suffer (some of them may have been protected by a previous attack, although I did not get any evidence that it was so), but, as in the burgh of Crosshill, a population of nearly 2,000 people were exposed to the same influences through the milk, and only 180 were affected, and these principally children, this circumstance does not appear to me to be either unusual or extraordinary. When these children were confined to bed, they lay for several days in the little bedroom opening into the kitchen, marked on the adjoining plan. The kitchen opened into the dairy. They were afterwards removed into the large room. The discharges of these children were thrown into the dungstead situated at the back of the byre. This dungstead, as is seen on the plan, is only a few yards from the well; the privy drained into it, and the pipe conducting the Eaglesham water into the well ran past the end of it. The disease in the back row came to an end—burned itself out, so to speak—in the beginning of January; the poisonous matter had, at the end of that month, been washed away by the rains; and had it not been for this fresh source of contamination, farmer X's well would have now been harmless. The poisonous matter from this dungstead must have soaked under the walls of the byre, or along the course of the water pipe into the well, and so poisoned it afresh. In the former case, the poison trickled over 800 yards of meadow, and might so be robbed of part of its virulence; but here the source of contamination was at hand, and so the epidemic broke out in Crosshill with greater violence than ever in the beginning of the third week in February.

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[1] Dr. Klein on the Minute Pathology of Enteric Fever. British Med. Journal, 5th Dec., 1874.

[2] Dr. Dougall on the Dissemination of Zymotic Diseases by Milk. Glas. Med. Journal, May, 1873.

It has been stated by the Eaglesham milk agent, since this inquiry into the milk origin of the epidemic became public, that no milk was taken by him to the Crosshill dairies from the farm of farmer X after the 9th of February. This statement was made at a time when he seemed to think that it would exonerate the milk which he supplied from any share in the origin of the epidemic; but, as one of the dairy proprietors informed me, when I made my first inquiries on the 22nd of February, that he understood that he was getting his milk from the farm of farmer X at that time. I do not place any reliance on this assertion. The supply of milk to Crosshill from the Eaglesham dairies was interdicted by the commissioners in the end of February. It will be seen by a glance at my abstract of cases (page 21) that the epidemic in Crosshill came to an end, as an epidemic of any magnitude, within ten days from that date. Taking the period of incubation above mentioned into consideration, the cessation of the epidemic corresponded with the stoppage of the milk supply from farmer X's farm, and thus the chain of evidence which connects this farmer's milk with the origin and spread of the Crosshill fever becomes complete.

It will be seen that in what I have called the first Crosshill epidemic, the evidence points to the water from the polluted well as the sole source of the milk contamination. In the second epidemic there were additional chances of contamination in the close proximity of the typhoid patients to the dairy; in the possible contamination of the dresses of those who attended the sick, and would almost certainly also be occasionally engaged in dairy work; and in the close proximity of the dungstead which received the typhoid excreta. An open door (as may be seen by a reference to the plan) exists in the back part of the byre, so that exhalations from the typhoid excreta in the dungstead might find their way into the milk during the milking operations in the byre.

But it may be asked, Was this the only source from which the Eaglesham milk agent or the Crosshill dairies got a tainted supply? I can only answer that I have not been able to discover any other. It has been asserted that the contamination may have occurred while the milk stood in the shops in Crosshill. Under the water closet in dairy A a defect was found in the soil pipe, so that liquid matter, and, no doubt, sewer gases oozed out under the floor of the water closet; but this water closet was at some distance from the room in which the milk stood, and during my daily attendance on the poor woman who died of the fever here I did not detect any smell of sewer gas in the lobby which intervened between the closet and the milk shop. This was explained by the fact that the floor of the closet was closely laid, and that the shaft or wooden case in which the soil pipe was enclosed acted as a ventilator to the cellar below the flooring, and carried the gases to the flats above. This defect was not of recent occurrence, but had existed for nearly two years. Further, the greater part of the milk did not remain in the shop, but was immediately carried out to the customers. When the case of fever occurred, the shop was shut; but the same milk was sent by dairyman A to the same customers from the dairy B in which no sanitary defects of this description have been discovered. It has also been alleged that defects were found in the pipes under dairy D, but on careful inquiry I have learned that this statement is untrue. In the cellar of the adjoining fish shop a very offensive fishy smell existed, and still exists. Down the wall of this cellar is conducted the iron soil pipe from the shop above. It was found, on careful examination, that the putty which is necessary to insure that the joints of the soil pipe are air-tight, had not been carried quite round two of the joints. On the side next the wall small crevices were thus left, from which sewer gases might escape; if so, as there was an open aperture between the cellar of that shop and the cellar of the milk shop, these gases might find their way into the cellar of dairy D, and through the flooring into the shop itself; but as these gases would be very much diluted before they reached the milk shop, and as we have evidence that in eight tenements in the immediate vicinity sewer gases were present in large quantity without any effect in spreading the fever, it will be seen that the chances of two small crevices in the soil pipe of an adjoining shop doing any harm to the milk in dairy B are very small indeed. Further, as dairies B and C, in which no sanitary defects have been alleged to exist in the sewer communications, gave rise to more cases of the fever than dairies A and D, we may dismiss this assertion without further notice.

A number of cases happened in houses in which no milk was got from the Eaglesham dairies, and a few of the people who did get milk from these dairies took ill so late in March that it is unlikely that they were poisoned by the tainted milk. How did these cases arise?—defects of drainage were discovered, as I believe they will everywhere be discovered when looked for in a number of houses and tenements. These defects are not at all peculiar to Crosshill; but on account of the amount of poisonous matter pouring daily into the drains and sewers, they very naturally exerted some influence in spreading the disease. To this source we may attribute most of the cases of the classes above indicated. Where typhoid fever occurred in a house or tenement, the cesspool or connecting drain of which was choked, the typhoid excreta would naturally accumulate on the side of the obstruction nearest to the house or tenement, and as the poisonous emanations, and the volumes of gas generated by its decomposition, could not get into the sewer, they would, if the soil pipes in these houses were perforated or cracked or inefficiently trapped, certainly flow back into the houses, even although the soil pipes were properly ventilated, as was usually the case in the burgh. I think it likely that, where the disease was propagated by emanations from the sewers, some obstruction in the connecting drains existed in houses or tenements into which typhoid had been carried by the milk. The facts mentioned with regard to the eight tenements in "No Man's Land" would lead me to believe that, under ordinary conditions, sewer gas would not propagate the disease, even when typhoid excreta were present in the sewers. In one case which came under my notice, and in which I was deeply interested, the only cause which could be discovered for the disease was a crack in the soil pipe in the top flat of a tenement in the ground flat of which the patient lived. This crack, the result of gross carelessness on the part of the plumber who put in the soil pipe, was found to exist immediately under the water closet of a family who had fever in the house. The discharges from the fever patient were thrown into this water closet, and a little liquid, no doubt containing the specific germs of typhoid, trickled down the soil pipe, and fell on the lobby floor of the ground flat in which this case happened.[1] As it has been proven most conclusively that the poison is most certain to take effect when it is taken into the stomach, there is no reason to believe that those persons who got and partook of the tainted milk were poisoned by sewer gases. In the majority of the houses no defects were discoverable; and in the minority of the houses in which defects were discovered, if the people were in the state of susceptibility in which their bodies formed a suitable soil for the poisonous germs, they were more likely to become affected by swallowing the poison than by inhaling it. How did the disease spread to Prospect Hill, in which the milk supply is different? Many of the families living there visited friends in Crosshill, in whose houses the disease prevailed. In these houses they were exposed to the germs of the disease in tainted milk, possibly on tainted clothes, possibly in tainted water.

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[1] I have discovered, since writing the above, that the patient in the top flat was recovered of the fever in the end of February, and as the patient in the ground flat got milk from dairy A, it is just as likely that this patient got the fever from poisoned milk. The day on which the first symptom of illness appeared in this case was March 24th, so that the period of incubation must have been at least twenty-six days.

In illustration of this, as a means of the spread of typhoid, I may mention the following case :—On the 20th of March a domestic servant sickened in a family (in "No Man's Land"), in which no fever existed, and whose milk supply was got entirely from dairy G. There were no defects discoverable in the water closet arrangements, and no smells had ever been complained of in that house. I found, however, that she had been in the habit of visiting an aunt who was cook in a family in which fever existed. She often took tea there with milk in it, and admitted to having taken a drink of milk itself on one occasion. The milk supply of that family was from dairy B. A few people living on Prospect Hill may have contracted the disease in this way. The typhoid poison, so introduced into the drainage, did not spread to any extent; only 7 or 8 people have been affected there in a population of 1,500. One tenement, in which two members of a family have been affected, has this history. In the end of April last the drain which is common to this and a neighbouring tenement got choked. It rained heavily at the time, and great quantities of liquid fœcal matter from the adjoining houses oozed up through a grating under the back window of a family living in the ground flat. For nearly two months this abominable filthy mass lay decomposing, and emitting foul odours, filling their back rooms with a horrible stench, and yet no case of fever happened in the tenement at that time. The drain was repaired in June, and no smells have been noticed since. This is another proof that drains, however defective, will not originate a specific fever, unless the germs of the disease have been introduced into them. In the adjoining tenement, a family, consisting of three persons, came on the 5th of March to a house which had not been previously occupied. They drank the water which had been lying in a cistern above the water-closet for some months, and into which, as the water in the traps in the closet must have evaporated during the time that the house was closed, no doubt the germs of typhoid had been carried by the sewer gases, and might be preserved and propagated by the necessarily impure state of the water. On the 2nd of April two of them were seized with typhoid fever. This illustration may explain how the fever may be propagated by prolonged exposure of the water in a cistern to the emanations from a sewer in which typhoid excreta exist.

6. *The influence of contagion by personal contact, and by infected clothing.*

The common experience of the profession is, that typhoid fever is not, as a rule, contagious *in the ordinary sense of the word.* Cases do occasionally happen, however, in which it appears to spread in this way. Sir William Jenner, in a recent lecture on the subject, cites the cases of two students who were engaged in taking the temperature of patients suffering from typhoid fever, before the registering thermometer was in use, and therefore were obliged, on each occasion, to put the head many times daily almost into the bed of the patient. They apparently contracted the disease in this way. As an illustration of the manner in which the clothes of nurses, and other persons in attendance on the sick, may acquire the power of communicating the disease to others, Dr. Budd, in his valuable work on typhoid fever, cites the following case: "In December, 1867, two young ladies, living in the country, about two miles apart, having been invited to a ball, were measured for new dresses on the same day, by the same dressmaker, who went for this purpose from one of these houses to the other, staying a considerable time in each. In the course of a fortnight both sickened from typhoid, and in both the attack proved to be very severe. They had not been away from home for several weeks before, and there was no fever in the immediate neighbourhood. But at the time when they were measured the dressmaker herself had been nursing a child of her own for several weeks in a very bad attack of typhoid fever. For a fortnight or more this woman had passed a great part of every day with her sick child on her lap, and, as there was severe diarrhœa, it is more than probable that her clothes had become more or less soiled with the specific excreta."

Believing that the danger of communicating the disease to the attendants on the sick does not depend on the ordinary emanations from the surface of the patient's body, or from the exhalations from the patient's lungs, but entirely on the decomposing discharges from the bowel, I was very careful to enjoin great cleanliness and disinfection of the typhoid stools. I believe that, on this account, the disease did not spread by contagion among my patients. Several cases came under my notice of mothers sleeping with children who were suffering from severe and protracted attacks of typhoid, and in no such case did the mother suffer.

Seven domestic servants (in seven different families, in only three of which the disease had previously existed), took typhoid, and in no case had the domestic anything to do with the attendance on the sick. Only one attendant on the sick took the disease in my practice. This was the case of a lady who was weakened by previous illness, and by long night and day attendance, first, on a daughter who died of the disease, and afterwards on a son who left the house when his sister was found to be suffering from typhoid, but who came home ill within a fortnight, and whose illness was severe and protracted. In no other case did any parent of, or attendant on, the sick contract the disease. Where the disease did spread in families, it seemed to spread because all the members of the family were exposed to the same influence. By way of illustration, I may relate the following case:—On the 25th of January, I was called to see a child, aged eight years, who had sickened of scarlet fever on the preceding day. This child had seven brothers, six of whom were immediately removed to a furnished house in the neighbourhood. The seventh, a boy aged ten years, had been complaining for a few days, and so was retained at home. His illness developed into a characteristic attack of typhoid. In two or three days one of the children who had been sent away was brought back, complaining of chillness, headache, and feverishness. This feverishness lasted three weeks. No other case happened in the family till the 28th of February, when another child, who had not had any communication with the sick, took the disease. The others were then taken home, and three of them were seized in rapid succession, including the child who had suffered from scarlet fever, and who had been kept apart up till that time. The only circumstance which formed a connecting link between these cases was that they all drank freely of milk from dairy A.

We now come to the consideration of the means by which the spread of typhoid fever may be prevented.

As I have formerly stated, I believe that the disease propagates itself by means of a specific element in the discharges from the bowel of the patient; and, I think, we have now good grounds for believing that the specific element consists of living germs, capable of self-propagation in a suitable soil. The evidence which has now been adduced to prove that the germs or virus of zymotic diseases may be produced *de novo* in the putrescent atmosphere of ill-smelling sewers and cesspools is not to my mind at all sufficient. When the writers who hold this view declare that they have met with sporadic cases of typhoid in remote country districts where previous cases of the disease were unknown, and that, after eliminating all other possibilities of origin they have traced its occurrence to exposure to a foul smell or the drinking of water contaminated with organic matter which did not contain typhoid excreta, they forget that a very innocent looking cup of tea taken in a friend's house in a neighbouring town or village may have contained the germ which was not found in the patient's immediate surroundings.

As vermin of every description may be exterminated from a country by the diligence of its inhabitants in destroying the parent stock, so, I believe that typhoid fever may be exterminated by the poisoning of its germs at the fountain head. This may be accomplished by the thorough disinfection of the discharges of the patient—of the linen, bedclothes, and clothing of the patient, of the clothing of the attendants on the patient, and of the apartment which the patient occupied during the illness. If we could insure the destruction of the disease germs produced by every individual case, we would, I believe, certainly bring about the extermination of the disease itself. Its subsequent origination in sewer gases would be as unlikely as the origination *de novo* of sewer rats. 1st, With regard to the disinfection of the typhoid discharges, I believe that the substances which are found most potent in destroying animalculae or microzymes, and in preventing the propagation of their germs, will be found to be the best disinfectants. Recent experiments, conducted by my friend Dr. Dougall,[1] show that, in this sense, the mineral acids are the truest disinfectants; they have been found to destroy the infective properties of vaccine lymph, which forms another argument in favour of their use in the destruction of zymotic poisons. I do not think, however, that we are justified in saying that a substance, such as carbolic acid, which has been found to be an excellent germicide, is not to be trusted as a disinfectant because it does not destroy the virus of vaccine lymph. As it is a germicide, and as I believe typhoid to be propagated by living germs, I think we are still justified in retaining it as a disinfectant in typhoid fever. In country places, where the discharges of the patient are to be thrown into a dungstead or privy, hydrochloric acid, which is one of the cheapest and most effective of the mineral acids, should be used. I believe that about a tablespoonful would be sufficient to insure the disinfection of one typhoid stool. The acid may be diluted with a little water, and then mixed with the typhoid excreta. Where water closets are in use with iron soil pipes, the use of free mineral acids would act injuriously on the iron, and so in cities we must accomplish the disinfection of the excreta by other means. A mixture of a solution of sulphate of iron and carbolic acid has been found, on the whole, the cheapest, safest, and most efficient disinfectant for typhoid excreta. A pound and a half of sulphate of iron and two ounces of liquid carbolic acid should be dissolved in a gallon of water. A teacupful of this mixture should be put into the night pan before it is used by the patient. Where these agents are not readily procurable, chloride of lime may be used instead, or, failing chloride of lime, a solution of permanganate of potash (Condy's fluid). 2nd. With regard to the disinfection of the patient's bedclothes and other articles of clothing, the easiest method of accomplishing this is by exposing them to a temperature of 300° Fahr.—a temperature at which all fever germs are destroyed. But this can only be done in a public institution where the proper appliances are at hand. The simplest method of disinfection, for ordinary use, is the immediate immersion of these articles in a tubful of water, containing a wineglassful of Condy's fluid or two tablespoonfuls of chloride of lime. The linen should afterwards be boiled before it is washed. Those articles of clothing, which cannot be treated in this way, should be placed in a closed room and thoroughly fumigated with sulphurous acid, prepared by burning a quantity of common brimstone in the apartment, or with chlorine gas, prepared by adding sulphuric acid to a mixture of common salt and binoxide of manganese. Chlorine gas should not be used for coloured articles, as it would certainly bleach them. The bedroom itself may be disinfected by the use of these gases. It should afterwards be repapered and repainted. These are general directions. The list of available agents might be greatly increased, but I think that the agents which I have mentioned are sufficient for the purpose of effectually destroying the fever germs.

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[1] "The Science of Disinfection," by John Dougall, M.D.

As, however, we cannot expect that the public in general will be educated in our generation to carry out any efficient system of disinfection, we must protect ourselves against the evil results of their ignorance and carelessness. As fever germs may get back into our houses by the agency of sewer gases, and as the deleterious effects of sewer gases weaken our bodies, and so convert them into a suitable soil for the propagation of these germs, we must use every means to exclude sewer gases from our houses. The means which seem to me, after a careful consideration of the subject, to be best calculated to insure their exclusion are—1st, The efficient trapping of the drain between the house and the sewer to prevent gases from getting back into the house drain from the sewer, and the ventilation of the trap. 2nd, The entire removal of a portion of the roof of the house drain, leaving it open for constant inspection, to insure that no accumulation or obstruction may take place between the trap and the house itself. This open part may be covered with a cage of charcoal to prevent noxious gases from impregnating the atmosphere around the house, an iron grating may be placed over the mouth of the opening, and its sides may be built up with brick.[1] 3rd, The soil pipe should be carried to the roof of the house, left open, and used to carry off the rain water. 4th, The waste pipes from the baths and fixed basins in connection with bedrooms, and the overflow pipes of cisterns, baths, and fixed basins should not be connected directly with the drain or sewer, but should all be carried into a pipe terminating in an open gutter, which gutter should empty into the opening into the house drain above recommended. 5th, The pipes and drains should be occasionally flushed with water, and, when there is fever in the family, disinfected daily by means of the combination of sulphate of iron and carbolic acid above recommended.

It will be seen from the history of the Crosshill epidemic that we cannot expect to secure immunity from typhoid fever, however perfect may be the sanitary arrangements of our houses, and however pure our water supply. The poison may be conveyed into our homes by the milk supply. The propagation of zymotic diseases by tainted milk has been investigated by only a few individuals, and these individuals have had their attention directed to this as a cause of typhoid fever only of late years. I have found records of five epidemics of typhoid which have been most conclusively traced to a poisoned milk supply. In order further to illustrate the importance of this subject, and the danger which is incurred from this source by every community in the nation, I have made an Appendix to this paper of extracts from the records of these epidemics, in the hope that thereby public attention may be seriously directed to the subject, and that the disgraceful sanitary conditions which gave rise to the Crosshill epidemic, and which are unfortunately too common in the farms and dairies of all parts of the kingdom, may be inquired into and removed by the proper authorities. The following is an extract from the report of Dr. Ballard, on the outbreak of typhoid fever at Armley in 1872, in which, when the handle of the pump which supplied the water from a poisoned well was tied up, the fever ceased. It is well worthy the attention of the local sanitary authorities in all parts of the country:—

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[1] I am indebted for this recommendation to my esteemed friend, Dr. Fergus, who has carried out this arrangement in his own house drain.

"It is not necessary that I should point the moral of this history, or deduce from it the warning that it must convey to any thoughtful mind. The Adulteration of Food Act of last session enables local authorities to deal with persons who add water to milk; but if a dairyman's own drinking water is permitted by local authorities to be a fluid little better than sewage, is it not rather a reflection on those authorities than an aggravation of his commercial fraud that he, only meaning to dilute his milk, ignorantly supplied infection to his customers?"

It has now been abundantly proven that fever poisons may be communicated to milk, where no commercial fraud has been committed, by the mere washing of milk dishes with poisoned water, or by the exposure of the milk itself in the vicinity of a fever patient. As local authorities, either from ignorance of sanitary matters, carelessness, or self-interest have in many cases neglected their duty of enforcing the removal of the objectionable sanitary conditions of our farmhouses and dairies which endanger the safety, not only of the farmers and dairymen themselves, but also of the public; it seems to me that a Government inquiry into this question is urgently demanded by its importance. Surely, when our legislators can find time to consider measures for the protection of game preserves and fisheries, they might devote a little attention to the consideration of a question which affects so largely the health and lives of the people.

APPENDIX.

I.

THE first epidemic of typhoid fever, traced to the use of tainted milk, of which I have been able to find any record, occurred in Penrith, in the year 1857. In September of that year a domestic servant, suffering from typhoid fever, was brought home from Liverpool to her parents in Penrith, who kept two or three cows, and retailed the milk to fourteen families in the town. Seven of these families took the disease. No case of the fever had happened in Penrith for some months before this girl's arrival. Two children in the dairy were subsequently affected. The following is an interesting abstract from Dr. Taylor's report of the epidemic:—[1]

"A person is the nurse and sole attendant on several children ill with fever; the cows are milked by her hands; the milk stands for a time in the same room where the sick are lying, exposed to an atmosphere of fever miasms. If the milk be capable of imbibing effluvia at all, it has every chance of doing so here. And that it has this property to a wonderful extent is well known to those accustomed to dairy management. From inquiries amongst those so engaged, I find there are many articles liable to impart a taste and odour to milk. Boiled fish is peculiarly obnoxious to the dairymaid, as being sure to taste the cream, and hasten the decomposition of milk; any meat the least tainted will do the same; onions, even from another room, will communicate their taste to milk, as will also turpentine from paint and varnishes, the smoke of tobacco, the smell of lime from plaster or whitewash. The operation of whitewashing the dairy is generally done at the season it contains the least milk. The fact of milk being a fluid in the highest degree susceptible of the least mustiness or putrescence, appears from what experience has taught as so necessary in the dairy—viz., scrupulous cleanliness and ventilation. Milk is also a fluid which not only absorbs animal effluvia with great readiness, but is also, from its constitution, and property of throwing to the surface an impervious cream, calculated to retain such with peculiar tenacity."

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[1] On the Communication of the Infection of Fever by Ingesta. By Michael Waistell Taylor, M.D. Edinburgh Medical Journal, 1858.

The second epidemic of typhoid which has been traced to the same cause happened in a small district of Islington in 1870. One hundred and forty-two families were supplied by a particular dairyman, and seventy of these families were invaded by typhoid within the ten weeks, from July 3rd to September 10th, during which the outbreak extended.

Suspicion rested on a fouled water-tank within the dairy premises, the water of which was used for washing the milk cans. The family of the dairyman, who died of the disease, denied that the water had ever been used for diluting the milk. I make the following extract from Dr. Ballard's report:—[1]

"Supposing that it is absolutely true that no water from the pump was purposely added by any one to the milk, we have yet left the admitted fact that the cans were washed at the pump. Is it probable that a small quantity of foul water, left in them after the process, would suffice to contaminate the whole bulk of milk subsequently introduced? I confess that, to my mind, this is not an impossibility. We all know how small—almost infinitesimal—an admixture of sewage will poison a well or running stream; nor is the idea of reproduction of typhoid contagium out of, within, or in the presence of, an appropriate organic material, at all foreign to prevailing opinions on the subject. Future experience may show that milk, which has remarkable relations to chemical ferments, is a substance peculiarly adapted also to the reproduction of marked contagia, or to the contagium of typhoid in particular."

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[1] "On an Outbreak of Typhoid Fever at Islington." By Edward Ballard, M.D. London: J. & A. Churchill.

The third epidemic in point of time which was connected with tainted milk, occurred in Armley, in the burgh of Leeds, in the year 1872. It was reported on by Dr. Ballard, who traced it to the milk supply of a particular dairy in which the dairyman himself was lying ill with typhoid fever, and where two of his children also suffered from the same disease. One hundred and seven cases occurred in this epidemic, which suddenly ceased on July 27th. The following is an extract from Dr. Ballard's report:—[1]

"This sudden cessation of the fever epidemic among this section of the community on July 27, means that the cause of the epidemic had ceased for them a fortnight or more previously; since, in enteric fever, there are commonly eleven days of incubation, and several other days before medical advice for its symptoms is sought, July 10 would therefore be about the time when the cause of the epidemic among customers of the dairy suddenly ceased to operate. Now, on July 10, Dr. Robinson had the handle of the pump at the Hall Lane Dairy chained up, and thenceforth it was kept chained. There was coincidence, therefore, between the cessation of the fever, and the cessation of the opportunity that the dairy had to supply a particular water; while there was no suggestion that the cows or their milk had undergone any change.

"It is, as I have said, not to be expected that evidence other than circumstantial evidence, should be obtainable respecting the admixture of water with the milk. If it occurred as an adulteration (such as dairymen are pretty generally accused of practising), the fact would be concealed; if accidentally, the fact would have escaped notice altogether, or would be forgotten.

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[1] "Official Report upon an Outbreak of Enteric Fever at Armley, Leeds, 1873."

"The dairyman's house is one of three cottages. The well is sunk (close to end wall) to a depth of 36 feet in the porous shale of the district. On removing stone cover, the depth of water was found to be 12 feet. A large dung-pit full of manure was situated about 5 yards off, and a privy and sunken tub for urine a few yards off in another direction. Four feet from surface, down to water, black matter could be observed oozing from between the bricks lining well, and at bottom a deposit of mud and filth was found, which gave off abundant bubbles of gas on being disturbed."

The fourth epidemic is, in some respects, similar in causation to the Crosshill epidemic. It also occurred in Leeds, in 1872, and is reported on by Dr. Robinson, the officer of health for the town, as follows:—[1]

"A farm-house in the country became infected with typhoid fever towards the latter end of September; the head of the house died, and subsequently five members of the household suffered from the disease. Milk from this infected source, purchased by a Leeds dairyman, is supplied to a certain respectable district of the town, in which locality a virulent outbreak of typhoid manifested itself, and eighty persons, who obtained their milk from this dairyman, contracted fever, fourteen of whom died. How, then, did the fever particles get into the milk? Probably in one of the following ways:—first, By being carried along with emanations from the sick, and deposition of poison in the cans, or direct contact of unclean clothes with the vessels during the time they remained in the house; or, secondly, Absorption by the milk of the typhoid miasmata, generated on the premises. With regard to the milk cans, these were taken into the kitchen, which opened direct into the sick room, to be washed and dried. On one of my visits to the house, I saw unclean linen placed side by side with the lids of the cans, on the same table; and, as the door of the sick room communicated immediately with both kitchen and dairy, and was generally open, the air of the sick room was common to the kitchen and dairy; the beds, in fact, were placed down stairs, in order that the double duty of attending upon the sick and household work might be more conveniently performed. With such arrangements therefore, it will readily be seen that abundant opportunity existed for contact of fever poison with the milk vessels during their stay in the house. Again, a glance at the plan shows the relative position the large manure heap (which the wet season had reduced to a very liquid condition) bears to the stable where the cows were milked, and the house and outbuildings generally. On to the surface of this reeking mass, measuring 66 feet long by 44 feet wide, the drain from the kitchen sink and slop stone poured its contents; and, in addition, the common privy, which received the typhoid excreta, was overflowing and also draining. Thus innumerable particles of poison must have been floating around the house, and, from their close contiguity, permeating the cow stable, in which vicinity the milk remained until sent away for distribution. Without alluding further to other modes in which the milk could be polluted under such circumstances as have been described, I think sufficient has been advanced to show, not only the possibility, but the almost certain probability of such a result accruing."

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[1] "Report on the Sanitary Condition of Leeds, 1872."

The fifth epidemic of typhoid connected with milk supply occurred at Parkhead, Glasgow, in January 1873, and was reported on by Dr. Russell, the medical officer for the City of Glasgow.[1] Of seventy-three families, supplied by a particular dairyman who had three children suffering from typhoid, twenty-two had fever. The person who habitually milked the cows also nursed the children. Of one hundred and forty-six families supplied by other dairymen, only two had fever. With regard to this outbreak, Dr. Russell has made the following remarks:—

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[1] "Glasgow Medical Journal," August, 1873.

"I regard this as an extreme illustration of what must frequently happen where the sale of articles of food is conducted in close connection with families with all their attendant ailments. Milk is, from its composition, a peculiarly favourable medium for the propagation of the germs of disease, and particularly of enteric fever. It is seldom that this fever is diffused by milk in circumstances which permit us to trace the disease home to the milk so clearly as in the Parkhead case; and it is very likely that many apparently inexplicable outbreaks of enteric fever in families are caused by milk, or even solid food, contaminated in the retail shops, especially among the poor. It is a very common practice in all parts of the city for parties to live and rear families in rooms behind shops, through which often the sole access lies, and in which groceries, milk, provisions of all kinds, sweetmeats, &c., are sold. These shops are "served" by one or both parents, or some grown-up child; and when infectious disease enters such a family, it cannot fail to be the source of quite peculiar risk to the public."

I shall conclude this appendix with the following extracts from Dr. Budd's valuable book on typhoid fever. In treating of its propagation by tainted milk, the writer says, "Two very important instances of the same kind have lately come under my own observation, and I have no doubt that this mode of infection is much more common than it is generally supposed to be." With regard to the following graphic narrative, which appeared in the *Bristol Times*, Dr. Budd states that he has ascertained from the writer that it is literally true; and, further, that the water with which the milkman replenished his cans received a large proportion of the sewage of the village of Stapleton, of two workhouses and of two infirmaries. It shows how the milk may become contaminated after it leaves the farm, and before it gets to the city dairy.

"In one of those flat outlying districts of Bristol, where moist meadows, dry cinder heaps, tall smoky chimneys, and the oozy bed of a flat low-lying river, contend for the mastery in the landscape—I, a few mornings since, found myself. Unpromising as was the scenery, my walk nevertheless led me through a pleasant green field, on which a number of cows was grazing, and where some milkmen were already filling their cans. Along the edge of the meadow a stream ran, not the most pellucid in the world, and a short lane led out thence into the road, which was skirted by the dwellings of those whom I would best designate by the title of the humbler of the middle class. Having often heard the popular opinion as to the questionable quality of the article sold to whiten our morning Souchong, I indignantly exclaimed to myself, as I saw one milkman shoulder his cans and start on his journey, "Now surely that milk can't but be genuine." I was a little too soon, however. The owner of the cans went not quite straight to the short lane aforesaid, but deviated on his way to the unpellucid brook. Uncovering his two cans at its edge, he caused one thereof to hang over the water, and the other the land, and then gently stooped his respectable person, until one vessel rested on the earth and the other received over its edge a bountiful supply of the running stream. When he had apparently satisfied himself with this process, he placed both his vessels on the earth, poured some of the contents of the one into the other, then back again—in fact, he brewed the beverage. Shouldering his cans then, and passing up the short lane and out into the street, he cried out, 'Milk!'"

II.

I think it right to state that, since the facts with regard to the water supply of farmer X have become public, the proprietor of the farm has put himself to considerable trouble and expense to discover another source of water supply for the farm. He has at length succeeded in discovering a spring in an adjoining field, so that no water is now to be taken from the Eaglesham source for domestic purposes. The manure heap, figured on the map, is to be removed to a safe distance from the house and well. I have made careful inquiry, and find that there is no fever at present in any of the farms which supply Crosshill with milk.

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